



SURFACE VEHICLE RECOMMENDED PRACTICE

J2292™

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(R) Combination Pelvic and Upper Torso Operator and Occupant
Restraint Systems for Off-Road Work Machines

RATIONALE

SAE J2292 has been reaffirmed to comply with the SAE Five-Year Review policy.

FOREWORD

This SAE Recommended Practice includes requirements for combination pelvic and upper torso restraint systems and testing of seat belt anchorages on off-road work machines and the testing of seat belt assemblies.

1. SCOPE

This SAE Recommended Practice establishes minimum performance and test requirements for combination pelvic and upper torso occupant restraint systems provided for off-road self-propelled work machines.

1.1 Purpose

This document applies to 3-point and 4-point occupant restraint systems (Type 2 and 2a) for off-road, self-propelled work machines fitted with ROPS.

1.2 Field of Application

1.2.1 A Type 2 belt is optional and may be used where upper torso restraint is desired. This document provides guidelines for, but does not imply in any way, that an upper torso occupant restraint system is required for off-road work machines.

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https://www.sae.org/standards/content/J2292_202108

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this publication to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J386 Operator Restraint Systems for Off-Road Work Machines

SAE J826 Devices for Use in Defining and Measuring Vehicle Seating Accommodation

2.1.2 ISO Publication

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 6683 Earth-Moving Machinery - Seat Belts and Seat Belt Anchorages

ISO 3411 Earth-Moving Machinery – Human Physical Dimensions of Operators and Minimum Operator Space Envelope

ISO 5353 Earth-Moving Machinery - Seat Index Point

ISO 11112 Earth-Moving Machinery - Operator's Seat-Dimensions and Requirements

3. DEFINITIONS

3.1 ADJUSTMENT HARDWARE

Hardware designed for adjusting the belt assembly to fit the user, including such hardware that may be integral with buckle, attachment hardware, or retractor.

3.2 ANCHORAGE

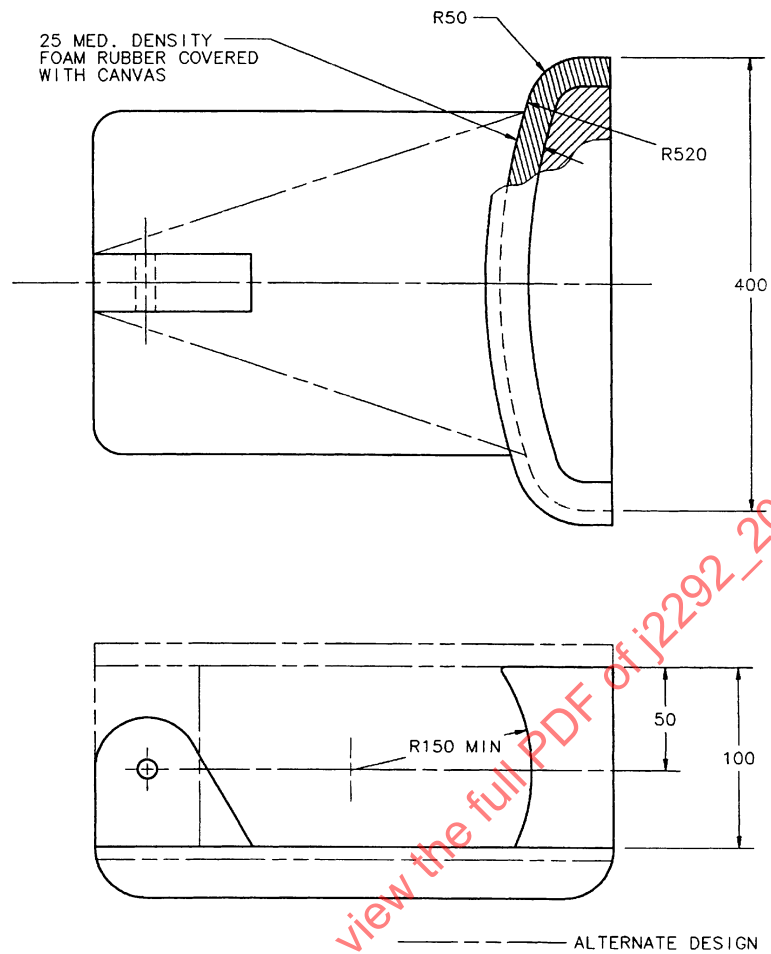
The point where the seat belt assembly or extension (tether) belt is mechanically attached to the seat system or machine.

3.3 ATTACHMENT HARDWARE

Hardware for securing a seat belt assembly to an anchorage on a seat system or on a machine.

3.4 BODY BLOCK

The test device used to apply the seat belt force to the seat system (reference Figures 1 and 2).



DIMENSIONS NOT SHOWN ARE OPTIONAL TO SATISFY THE TEST FACILITY AND DO NOT INFLUENCE THE TEST RESULTS.

Figure 1 - Pelvic body block

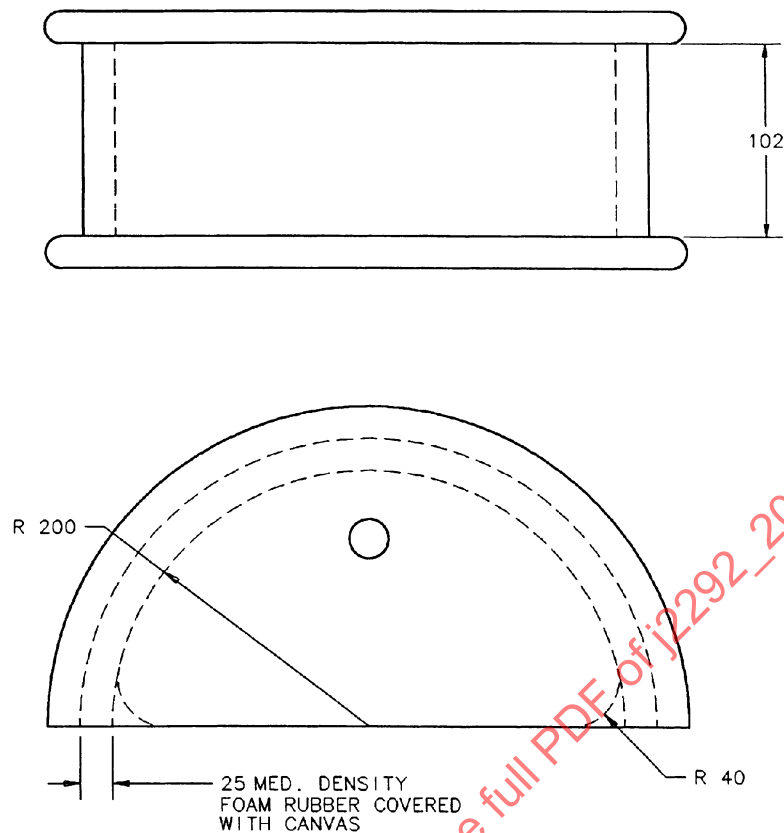


Figure 2 - Torso body block

3.5 BUCKLE

A quick release component of a seat belt assembly which accepts and connects to a latch plate and is intended to facilitate wearing and removal of the seat belt by an occupant.

3.6 MICRO-SLIP (CREEP)

The amount of unintentional lengthening of the seat belt assembly loop during use that is caused by motion of the machine, the seat, and the seat belted occupant.

3.7 EXTENSION (TETHER) BELT

Any strap, belt, or similar device (webbing, wire cable, solid link, etc.) that aids in the transfer of seat belt forces.

3.8 HARDWARE

Any metal or rigid plastic part of the restraint system.

3.9 H-POINT

The pivot axis between a human torso and thigh as defined by the H-point template and H-point machine in SAE J826.

3.10 LOOP

The portion of the seat belt assembly as it would be installed around the seat occupant.

3.11 LATCH PLATE

A load bearing device through which the seat belt webbing either passes or is permanently attached. Allows the webbing to change direction and connect with the buckle. Also known as a tongue, tip, or simply as a latch. Latch plate variants include free falling/dropping, sliding, cinching/locking, semi-cinching, sewn-in.

3.11.1 Dropping. Free falling, and sliding types

A latch plate which permits webbing transfer through the latch plate in two directions in response to loading and will fall under its own weight along a vertical length of webbing.

3.11.2 Free running types, self parking types

A latch plate which permits webbing transfer through the latch plate in two directions in response to loading and will remain in place under its own weight along a vertical length of webbing, but can easily be moved.

3.11.3 Locking or cinching types

A latch plate which limits transfer of the webbing through the latch plate in at least one direction in response to loading sufficient to meet the loop load requirements of SAE J386.

3.11.4 Semi cinching type

A latch plate which limits transfer of the webbing through the latch plate in at least one direction in response to loading sufficient to meet the requirements defined in this document, but is not intended to limit the transfer of webbing during dynamic (rollover or crash) loading.

3.12 OCCUPANT RESTRAINT SYSTEM

The total system composed of the seat belt assembly, seat system, anchorages, and extension (tether) belts, if applicable, which transfers the seat belt force to a machine.

3.13 POLYESTER YARN

Yarns spun from polyethylene terephthalate.

3.14 RETRACTORS

Devices for storing all or part of the strap material of a seat belt assembly.

3.15 AUTOMATIC LOCKING RETRACTOR (ALR)

A retractor incorporating a positive self-locking mechanism that remains engaged, locked, and capable of withstanding restraint forces once webbing has initially been extracted. This locking mechanism is reset when the webbing is allowed to retract into the retractor. The retractor may allow up to 76 mm, of webbing movement before retracting webbing to the next locking position.

3.16 EMERGENCY LOCKING RETRACTOR (ELR)

A retractor incorporating adjustment hardware by means of a locking mechanism that is activated by vehicle acceleration or rollover (single sensitivity), strapping acceleration, or other automatic action during an emergency (multiple sensitivity) and is capable when locked of withstanding restraint forces.

3.17 NONLOCKING RETRACTOR

A webbing stowage device from which the strap is extracted to its full length by a small external force and which provides no adjustment for the length of the extracted strap and no means for locking any strap not extracted from the mechanism at any time including an emergency.

3.18 ROPING

The tendency of a piece of material to twist upon itself or roll up transversely, remaining in the form of a rope instead of staying in its original strap form.

3.19 SEAT BELT ASSEMBLY

Any strap, webbing, or similar device designed to provide occupant restraint in a machine. It includes buckles or other features, and may include the attachment hardware for installing the seat belt assembly to an anchorage.

3.19.1 Type 1 seat belt assembly

A seat belt assembly which provides pelvic restraint.

3.19.2 Type 2 seat belt assembly

A seat belt assembly which provides both pelvic and upper torso restraint. This includes what is commonly referred to as 3-point and 4-point belt systems.

3.19.3 Type 2a seat belt assembly

A seat belt assembly consisting of a separate upper torso restraint intended for use only in conjunction with a Type 1 seat belt assembly and when combined make up a Type 2 seat belt assembly.

3.20 SHOULDER REFERENCE POINT

A point 563 mm above the H-point along the torso centerline of the two-dimensional drafting template described in SAE J826.

3.21 UPPER TORSO RESTRAINT

Portion of a seat belt assembly intended to restrain movement of the chest and shoulder regions.

3.22 PELVIC RESTRAINT

Seat belt assembly or portion thereof intended to restrain movement of the pelvis.

3.23 SEAT INDEX POINT (SIP)

The point in the central, vertical plane of the SIP measuring device when installed in the seat as defined in ISO 5353.

3.24 SEAT SYSTEM

The total support mechanism between the machine and the occupant interface. This would include any seat assembly, fixed or adjustable seat support, seat suspension (flexible seat support), or other elements connecting the occupant to the machine.

3.25 SEAT UPPER

The portion of the seat system above fore-aft, vertical or rotational adjustments. Typically includes the seat back, seat cushion, head rest, recliners, arm rest, etc.

4. TECHNICAL REQUIREMENTS, TESTING, AND PERFORMANCE OF SEAT BELTS

4.1 Seat Belt Assembly General Requirements

4.1.1 Single occupancy

A seat belt assembly shall be designed for use by one, and only one, person at any time.

4.1.2 Release

The seat belt assembly shall be provided with a buckle or latch readily accessible to the occupant and shall be designed to provide easy and rapid release of the assembly with a single motion. It shall also be capable of being released with either hand, bare or mittened. The buckle shall be designed to minimize the possibility of accidental release due to occupant movement, inertia, or external forces. The buckle shall meet all the requirements described in 4.4.

4.1.3 Adjustment

The seat belt shall be self-adjusting or readily adjustable by a means within easy reach of the occupant. In all operating positions, adjustment to a snug condition shall at least accommodate the 5th percentile occupant to the 95th percentile arctic-clothed occupant, reference ISO 3411.

4.1.4 Micro slip

Any seat belt loop utilizing manual length adjusters in place of a retractor, the adjusters shall meet the micro-slip requirements outlined in SAE J386.

4.1.5 Breaking strength

The components of a seat belt assembly including webbing, straps, buckles, adjustment and attachment hardware, and retractors shall comply with the following requirements.

- 4.1.5.1 The structural components in the pelvic restraint of a Type 2 seat belt assembly shall withstand a tensile force of not less than 11.1 kN applied by a Tensile Force Testing Machine as described in SAE J386.
- 4.1.5.2 The structural components in the upper torso restraint of a Type 2 or Type 2a seat belt assembly shall withstand a tensile force of not less than 6.7 kN when tested by the Breaking Strength procedure specified in SAE J386.
- 4.1.5.3 The structural components common in the pelvic and upper torso restraints shall withstand a tensile force of not less than 13.3 kN when tested by the Breaking Strength procedure specified in SAE J386.

4.1.6 Marking (labeling)

Each seat belt assembly or each section of belt assembly, or both, shall be permanently and legibly labeled with year of manufacture, model or style number, and name or trademark of manufacturer or importer, and shall state compliance with SAE J2292.

4.1.7 Usage and maintenance instructions

Seat belt assemblies when packaged separately shall be accompanied by written instructions for:

- a. Proper installation, including the proper manner of threading the strap into the attachment hardware when threadable hardware is supplied.
- b. Proper wearing of the installed assembly.
- c. Proper maintenance (including cleaning procedures) and periodic inspection for wear or damage.

4.2 Latch Plate Requirements

- 4.2.1 Latch plates shall be capable of maintaining strap tension and limiting extension in the pelvic portion of the seat belt assembly. Dropping, free falling, sliding, free running, or self parking type latch plates shall not be used.
- 4.2.2 Locking and semi cinching latch plates shall meet the requirements for adjustment force and tilt lock adjustment specified in SAE J386 during normal operating conditions.
- 4.2.3 In the case of restraint systems including at least one emergency locking retractor and not meeting the SAE J386 requirements for Type 1 and Type 2a pelvic restraint, the length of the strap in the pelvic restraint loop shall not increase more than 40 mm due to strap movement through the latch plate when tested as follows.
 - 4.2.3.1 Testing shall be performed on-machine or in a manner equivalent to an on-machine condition. Locate a reference point A on the buckle or latch plate as appropriate. Locate a reference point B on the attachment hardware or retractor assembly mounting point at the other end of the pelvic portion of the seat belt assembly. Adjust the pelvic portion of the seat belt assembly as necessary so that the webbing between points A and B is between 1000 mm and 1500 mm and is at least 125 mm less than the maximum length allowed by the belt system. Using a tension pull device of similar width as the pelvic body block shown in Figure 1, apply a pre-load of 45 N to the pelvic portion of the seat belt assembly in the direction the seat faces with an application force of 45 degrees above the horizontal (reference Figure 5 pelvic portion only). Measure and record the length of belt between points A and B along the longitudinal centerline of the webbing for the lap belt or lap belt portion of the seat belt assembly while the preload is being applied. Increase the load to 670 N at an onset rate of not more than 222 N per second. Attain the 670 N load in not more than 10 seconds. Maintain the 670 N load for at least 5 seconds. Measure and record the length of belt between points A and B while the load is being applied.

4.3 Strap Material Requirements

- 4.3.1 Strap material requirements are the same as specified in SAE J386.

4.4 Buckle Requirements

- 4.4.1 Buckle requirements are the same as specified in SAE J386.

4.5 Hardware Requirements

4.5.1 Hardware (including attachment hardware) requirements are the same as specified in SAE J386.

4.5.1.1 Attaching bolts used to secure the upper torso ends of seat belts to the seat belt anchorages shall withstand tensile forces of 17.8 kN.

4.5.1.2 Attaching bolts used to secure common attachment for pelvic and upper torso ends of seat belts to the seat belt anchorages shall withstand tensile forces of 26.7 kN.

4.6 Retractors

Retractors shall meet the seat belt assembly strength requirements of 4.1.5. When a locking retractor is included in a seat belt assembly, it shall be locked at the start of the seat belt assembly strength test. Retractors should meet the environmental test requirements and cycle life requirements specified in SAE J386 and be consistent with the environments in which they are used.

NOTE: Emergency locking retractors should have a vehicle sensitivity which is appropriate for machine application while providing appropriate locking in machine rollover conditions.

4.6.1 Retractors sensitive to webbing withdrawal only shall not be used for upper torso restraint unless the pelvic portion of the restraint meets Type 1 or 2a requirements defined in SAE J386.

4.6.2 Retractors sensitive to webbing withdrawal only shall not be used for the pelvic portion of the restraint system.

4.6.3 When an Emergency Locking Retractor is used in the upper torso portion of a single retractor restraint system, a locking or semi cinching latch plate shall be used in the pelvic portion of the restraint system.

5. TECHNICAL REQUIREMENTS, MACHINE RELATED

5.1 Anchorages

5.1.1 Anchorages on the seat system or machine shall be such that the belt assembly can be readily installed or replaced and shall comply with the force requirement of 5.2.2.

5.1.2 If the seat does not swivel or have a suspension system, the pelvic portion of the seat belt assembly may be anchored to the seat or to the machine at any point within the cross-hatched zone shown in Figure 3.

5.1.3 If the seat is supported by a suspension system, the Type 1 seat belt assembly or pelvic portion of a Type 2 seat belt assembly shall be attached in such a way that the loop size of the belt does not change as the seat oscillates through its suspension's travel. The loop size of the upper torso restraint of a Type 2 or Type 2a seat belt assembly can change as the seat is adjusted or oscillates.

5.1.4 Extension (tether) belts

Belts, cables, or similar flexible devices may be used to transfer the seat belt assembly forces from the seat anchorages to the machine. The extension belt length may be adjustable.

5.1.5 Extension belts shall meet the seat belt assembly force requirements of 5.2.2 in all operating positions.

5.1.6 Seat belt assembly installation

- 5.1.6.1 Identify the Translating Seat Index Point (TSIP) which is identical to the SIP measured when the seat system is in the center travel position. The TSIP shall move with the seat upper as the seat moves through the total range of motion (fore/aft, up/down, side to side, and rotational). The anchorages for the pelvic portion of the seat belt assembly shall be located such that when the seat belts are in a straight line through TSIP, the angle formed from the horizontal shall be in the range of $60^\circ \pm 15^\circ$ as shown in Figure 3 for all seat operating positions. Where practical, the preferred angle through the TSIP is toward the more vertical.

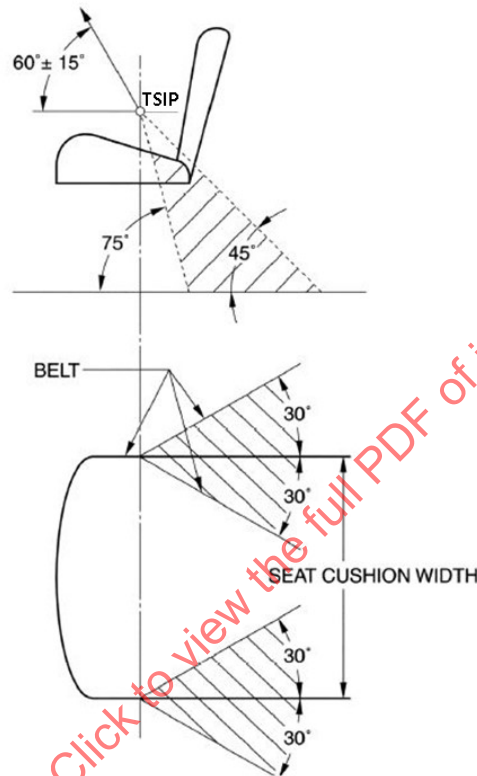


Figure 3 - Location of seat belt anchorage for pelvic portion of a type 2 and type 2a seat belt system with respect to seat index point

- 5.1.6.2 The lower anchorage of the upper torso restraint may be common with the pelvic restraint anchorage.
- 5.1.6.3 When the seat is in the rearmost and lowest position, the suspension, if present, in its mid-ride position, and the seat back is in its most upright work position, the upper anchorages of the upper torso restraint shall be located within the acceptable range shown in Figure 4.